



# ADAPTIVE FILTER TO REDUCE MULTIPATH

## ABSTRACT

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The direct path of a radio signal from the transmitter to the receiver is frequently interfered with by reflections of the transmitted signal from stationary and moving objects. These reflections are known as multipath noise. The multipath canceler of this invention takes as input the direct path signal plus multipath noise. The canceler, after canceling the multipath noise, outputs a purified version of the direct path signal nearly devoid of multipath noise. The output of the canceler is fed back to a bank of delayers and frequency shifters. The outputs of this bank of delayers and frequency shifters are multiplied by a set of adjustable coefficients. These coefficients are adjusted to form very accurate replicas of the multipath reflections caused by each reflector. Which replicas are subtracted from the input which is the original direct path signal plus the multipath noise. The result of this subtraction is called the residual and is a purified version of the direct path signal nearly devoid of multipath noise. The coefficients are determined by nonlinear least squares which finds that set of coefficients which minimize the mean square of the residual. Each coefficient is associated with a delay and a frequency shift. The amplitude of a coefficient is a measure of the magnitude of a reflector and the differential delay and frequency shift caused by said reflector. If an object is a target, its differential range, range rate and magnitude is got from the measured differential delay, frequency shift and amplitude of the coefficient. Position and velocity of the target can be obtained by geometric triangulation with multiple transmitters. Target angle can be measured from the relative phase angles of the corresponding filter coefficients, if complex, across multiple antennas receiving the same signal from the same transmitter. The system, comprising the

antennas, receivers, signal processors, multipath cancelers and target estimators, can be used on a surveillance aircraft to cancel ground reflections and track targets.